REMARKS

The Official Action dated July 19, 2004 has been carefully considered. Accordingly, the changes presented herewith, taken with the following remarks, are believed sufficient to place the present application in condition for allowance. Reconsideration is respectfully requested.

In the present amendment, claims 5 and 10 have been cancelled and claims 1, 11 and 12 have been amended. Support for the amendments may be found at pages 3 and 4. Since these changes do not involve any introduction of new matter, entry is believed to be in order and is respectfully requested.

In the Official Action, the Examiner objected to claim 5 as being indefinite. Claim 5 has been cancelled, thereby mooting the Examiner's objection. Reconsideration is respectfully requested.

Claims 1-15 were rejected under 35 U.S.C. § 101 as being directed to non-statutory matter. The Examiner asserted that claims 1-15 set forth a system that is not computer dependent since all of the claimed features may be implemented by way of a manual tuning technique, a technique the applicant readily discloses as being known at the time the invention was made.

However, as will be set forth in detail below, it is submitted that the methods and systems for tuning a feedforward compensation parameter in a motion control system set forth by claims 1-15 contain statutory subject matter. Accordingly, this rejection is traversed and reconsideration is respectfully requested.

As defined by claim 1, the present invention is directed to a method for automatically tuning a feedforward compensation parameter in a motion control system, the method comprising:

a) determining an initial value of the feedforward compensation parameter;

b) commanding an initial movement of an actuator according to a test motion routine, wherein the initial value of the parameter is used in the control of the actuator;

c) determining error associated with the initial movement;

d) determining a potential value of the feedforward compensation parameter;

e) commanding a movement of the actuator according to the test motion routine, wherein the potential value of the parameter is used in the control of the actuator;

f) determining error associated with the movement commanded in act e);

g) comparing the errors associated with the movements;

h) based on the act of comparing the errors, selecting one of the values as a current best value; and

i) repeating acts d) - h) until the current best value is an optimum value, wherein the act of comparing the errors associated with the movements comprises comparing the errors associated with at least two of the movements.

The Examiner asserted that the manual tuning technique disclosed at page 3, lines 1-10 discloses all of the claimed features of the present invention. The Applicant finds no teaching or suggestion at page 3, lines 1-10 of comparing the error associated with movement based on an initial compensation parameter with the error associated with movement based on a potential value compensation parameter and selecting one of the values as a current best value. In addition, the Examiner's attention is directed to page 3, lines 10-22. As noted "manual tuning took a considerable amount of time, and often provided less than accurate estimates. Moreover, the manual tuning of feedforward gains required an engineer or technician with sufficient knowledge of the control system and the required calculations. In addition, there was not a reliable way of determining whether the model developed from the manual calculations accurately described the actual system dynamics."

"[T]he transformation of data, representing discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price, constitutes a practical application of a mathematical algorithm, formula, or calculation, because it produces 'a useful, concrete and tangible result'--a final share price momentarily fixed for recording and reporting purposes and even accepted and relied upon by regulatory authorities and in subsequent trades." *State St. Bank & Trust Co. v. Signature Fin. Group*, 149 F.3d 1368, 1373 (Fed. Cir. 1998). As demonstrated by the improvements over the prior art manual tuning, the present claimed invention does produce a useful, concrete and tangible result and accordingly the rejection based on statutory subject matter has been overcome. Reconsideration is respectfully requested.

In the Official Action, the Examiner rejected claims 1-3, 7, 10, 13-14 and 19-20 under 35 U.S.C. § 102(e) as being anticipated by Christ et al. (U.S. Patent No. 6,658,370). The Examiner asserted that Christ et al. teach an automatic tuning method which adequately teaches the claimed invention. The Examiner asserted that all of the claimed features, including the tuning of feedforward parameters, based on error determinations, wherein tuning takes place periodically over time, so that optimal tuning constants may be found for a servo motor are adequately taught by way of Christ et al. The Examiner further asserted that an initial value, an initial movement, a test routine, a potential value, a second movement, and determining an error with the movements and repeating this until optimum values are obtained for tuning constants are all features that are inherent to Christ et al. since there must be values which are used for the first values and since the movements of each axis, are measured periodically over time, so that new tuning constants may be used if an error is deemed to be outside an acceptable threshold.

However, as will be set forth in detail below, it is submitted that the methods and systems for tuning a feedforward compensation parameter in a motion control system set

forth by claims 1-3, 7, 10, 13-14 and 19-20 are not anticipated by Christ et al. Accordingly, this rejection is traversed and reconsideration is respectfully requested.

As defined by claim 1, the present invention is directed to a method for automatically tuning a feedforward compensation parameter in a motion control system, the method comprising:

a) determining an initial value of the feedforward compensation parameter;

b) commanding an initial movement of an actuator according to a test motion routine, wherein the initial value of the parameter is used in the control of the actuator;

c) determining error associated with the initial movement;

d) determining a potential value of the feedforward compensation parameter;

e) commanding a movement of the actuator according to the test motion routine, wherein the potential value of the parameter is used in the control of the actuator;

f) determining error associated with the movement commanded in act e);

g) comparing the errors associated with the movements;

h) based on the act of comparing the errors, selecting one of the values as a current best value; and

i) repeating acts d) - h) until the current best value is an optimum value, wherein the act of comparing the errors associated with the movements comprises comparing the errors associated with at least two of the movements.

As defined by claim 13, the present invention is directed a method for tuning a compensation parameter in a motion control system having an actuator, wherein the motion control system utilizes a position command and a feedforward command to control motion of the actuator, and the compensation parameter compensates for a time-shifted relationship between the position command and the feedforward command, the method comprising:

a) determining an initial value of the compensation parameter;

b) commanding an initial movement of the actuator according to a test motion routine, wherein the initial value of the parameter is used in the control of the actuator;

c) determining error associated with the initial movement;

d) determining a potential value of the parameter;

e) commanding a movement of the actuator according to the test motion routine, wherein the potential value of the parameter is used in the control of the actuator;

f) determining error associated with the movement commanded in act e);

g) comparing the errors associated with the movements;

h) based on the act of comparing the errors, selecting one of the values as a current best value; and

i) repeating acts d) - h) until the current best value is an optimum value, wherein the act of comparing the errors associated with the movements comprises comparing the errors associated with at least two of the movements.

Christ et al. is directed to method and system for adaptively and automatically retuning a closed-loop servo motor that is operating within normal limits. A first active set of configurable tuning constants is assigned to the servo motor, and motor performance is periodically measured to determine if performance is outside a retuning threshold, in which case the active set of configurable tuning constants is replaced by selecting a replacement set of tuning constants from a finite group of discrete predesigned set of tuning constants. Actual performance of the servo motor is remeasured, and this process is repeated if the performance remains outside the retuning threshold. The predesigned sets of tuning constants are derived and stored in the servo software, typically as a result of pretesting the servo motor model by the manufacturer, for example using manual retuning.

To anticipate, every element and limitation of the claimed invention must be found in a single prior art reference, arranged as in the claim. *Karsten Mfg. Corp. v. Cleveland Golf*

Co., 242 F3d 1376, 1383, 58 U.S.P.Q.2d 1286, 1291 (Fed. Cir. 2001); *Scripps Clinic & Research Foundation v. Genentech, Inc.*, 927 F.2d 1565, 1576, 18 U.S.P.Q.2d 1001, 1010 (Fed. Cir. 1991). Further, the reference must describe the Applicant's claimed invention sufficiently to place a person of ordinary skill in the field of the invention in possession of it. *Akzo N.V. v. United States Int'l Trade Comm'n*, 808 F.2d 1471, 1479, 1 U.S.P.Q.2d 1241, 1245 (Fed. Cir. 1986), *cert denied*, 482 U.S. 909 (1987); *In re Coker*, 463 F.2d 1344, 1348, 175 U.S.P.Q. 26, 29 (CCPA 1972).

Applicant finds no teaching or disclosure in Christ et al. of a method for tuning a feedforward compensation parameter in a motion control system comprising, *inter alia*, the act of: c) determining error associated with the initial movement; d) **determining a potential value of the feedforward compensation parameter; e) commanding a movement of the actuator according to the test motion routine, wherein the potential value of the parameter is used in the control of the actuator; f) determining error associated with the movement commanded in act e); g) comparing the errors associated with the movements; h) based on the act of comparing the errors, selecting one of the values as a current best value**; and i) repeating acts d) - h) until the current best value is an optimum value, wherein the act of comparing the errors associated with the movements comprises comparing the errors associated with at least two of the movements.

As defined by claim 14, the present invention is directed to a motion control system comprising:

a) a position command generator adapted to produce position commands;

b) a feedforward command generator adapted to produce feedforward commands based upon feedforward compensation parameters, wherein one of the feedforward compensation parameters comprises a time-shift compensation parameter that compensates for a time-shifted relationship between the position command and the feedforward command;

d) a controller adapted to communicate with an actuator, the position command generator, and the feedforward command generator, and adapted to control the motion of the actuator based upon the position commands and the feedforward commands; and

e) a feedforward tuning unit adapted to:

i) determine an initial value of the time-shift compensation parameter;

ii) cause the position command generator to produce position commands according to a test motion routine, wherein the initial value of the time-shift compensation parameter is used in the control of the actuator and the actuator undergoes an initial movement;

iii) determine error associated with the initial movement;

iv) determine a potential value of the time-shift compensation parameter;

v) cause the position command generator to produce position commands according to the test motion routine, wherein the potential value of the time-shift compensation parameter is used in the control of the actuator and the actuator undergoes movement;

vi) determine error associated with the movement wherein the potential value was used in the control of the actuator;

vii) compare the errors associated with the movements;

viii) select one of the values as a current best value based on the comparison; and

ix) repeat actions in iv) - viii) until the current best value is an optimum value, wherein the feedforward tuning unit compares the errors associated with at least two of the movements.

Applicant finds no teaching or disclosure in Christ et al. of a motion control system comprising, *inter alia*, a feedforward tuning unit adapted to: i) determine an initial value of

the time-shift compensation parameter; ii) cause the position command generator to produce position commands according to a test motion routine, wherein the initial value of the time-shift compensation parameter is used in the control of the actuator and the actuator undergoes an initial movement; **iii) determine error associated with the initial movement; iv) determine a potential value of the time-shift compensation parameter; v) cause the position command generator to produce position commands according to the test motion routine, wherein the potential value of the time-shift compensation parameter is used in the control of the actuator and the actuator undergoes movement; vi) determine error associated with the movement wherein the potential value was used in the control of the actuator; vii) compare the errors associated with the movements; viii) select one of the values as a current best value based on the comparison**; and ix) repeat actions in iv) - viii) until the current best value is an optimum value, wherein the feedforward tuning unit compares the errors associated with at least two of the movements.

Christ et al. disclose measuring the performance to determine if it is outside a retuning threshold, but Christ et al. fail to disclose or suggest comparing multiple compensation values against each other to determine the best value. Christ et al. simply measures the error against the error threshold and then if unacceptable, the method selects another predetermined value and measures that error against the error threshold rather than comparing that error value against the previous error value.

Among other reasons, as every element and limitation of claims 1-3, 7, 10, 13-14 and 19-20, as arranged therein, cannot be found in Christ et al., Christ et al. do not anticipate the presently claimed invention. Whereby, the rejection has been overcome and reconsideration is respectfully requested.

In the Official Action, claims 4-5, 8-9 and 11-12 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Christ et al. in view of Official Notice. The Examiner

conceded that Christ et al. do not disclose determining certain tuning parameters before running the tuning method. The Examiner asserted that this is an obvious variation and would add to the desired abilities of Christ et al. since it would provide a system with fewer computations that would otherwise need to be done in real time and this has the obvious effect of saving time during the tuning method, and this would have been obvious to one of ordinary skill in the art at the time the invention was made.

However, as will be set forth in detail below, it is submitted that the methods defined by claims 4, 8-9 and 11-12 are non-obvious and patentably distinguishable from Christ et al. in view of Official Notice. Accordingly, this rejection is traversed and reconsideration is respectfully requested.

To establish prima facie obviousness of the claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981; 180 U.S.P.Q. 580 (CCPA 1974). Moreover, in order for references to be relied upon to support a rejection under 35 U.S.C. § 103 they must provide an enabling disclosure, i.e., they must place the claimed invention in the possession of the public. *Glaxo Inc. v. Novopharm Ltd.*, 34 U.S.P.Q.2d, 1565 (Fed. Cir. 1995); *In re Payne*, 203 U.S.P.Q. 245 (CCPA 1979). Christ et al. in view of Official Notice fail to satisfy these requirements.

The teachings of Christ et al. are discussed above. The deficiencies of Christ et al. are not overcome with the combination of Official Notice. Moreover, Official Notice alone or in combination with Christ et al., fail to teach or suggest a method for tuning a feedforward compensation parameter in a motion control system, the method comprising, *inter alia*, the act of: c) determining error associated with the initial movement; d) determining a potential value of the feedforward compensation parameter; e) commanding a movement of the actuator according to the test motion routine, wherein the potential value of the parameter is used in the control of the actuator; f) determining error associated with the movement

commanded in act e); g) comparing the errors associated with the movements; h) based on the act of comparing the errors, selecting one of the values as a current best value; and i) repeating acts d) - h) until the current best value is an optimum value, wherein the act of comparing the errors associated with the movements comprises comparing the errors associated with at least two of the movements.

It is therefore submitted that the presently claimed methods are nonobvious over and patentably distinguishable from Christ et al. in view of Official Notice, whereby the rejection under 35 U.S.C. §103 has been overcome. Reconsideration is respectfully requested.

In the Official Action, claim 6 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Christ et al. in view of Heiman et al. (U.S. Patent No. 6,604,211). The Examiner conceded that Christ et al. do not teach a test routine to be a sinusoidal waveform for commanding movement of an axis. The Examiner asserted that Heiman et al. disclose an actuating method for an axis to utilize a sinusoidal waveform for actuations of a particular axis. The Examiner further asserted it would have been obvious to one of ordinary skill in the art to have incorporated the teachings of Heiman et al. into Christ et al. for the purpose of allowing for the output frequencies to be analyzed so that error(s) may be effectively and quickly ascertained.

However, as will be set forth in detail below, it is submitted that the method defined by claim 6 is non-obvious and patentably distinguishable from Christ et al. in view of Heiman et al. Accordingly, this rejection is traversed and reconsideration is respectfully requested.

As noted above, to establish prima facie obviousness of the claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka, supra.* Moreover, in order for references to be relied upon to support a rejection under 35 U.S.C. § 103 they must provide an enabling disclosure, i.e., they must place the claimed invention in the

possession of the public. *Glaxo Inc. v. Novopharm Ltd., supra*; *In re Payne, supra*. Christ et al. in view of Heiman et al. fail to satisfy these requirements.

The teachings of Christ et al. are discussed above. Heiman et al. disclose a method and apparatus for initiating and analyzing an error recovery procedure in a data storage device. The deficiencies of Christ et al. are not overcome with the combination of Heiman et al. Moreover, Heiman et al. alone or in combination with Christ et al., fail to teach or suggest a method for tuning a feedforward compensation parameter in a motion control system, the method comprising, *inter alia*, the act of: c) determining error associated with the initial movement; d) determining a potential value of the feedforward compensation parameter; e) commanding a movement of the actuator according to the test motion routine, wherein the potential value of the parameter is used in the control of the actuator; f) determining error associated with the movement commanded in act e); g) comparing the errors associated with the movements; h) based on the act of comparing the errors, selecting one of the values as a current best value; and i) repeating acts d) - h) until the current best value is an optimum value, wherein the act of comparing the errors associated with the movements comprises comparing the errors associated with at least two of the movements.

It is therefore submitted that the presently claimed methods are nonobvious over and patentably distinguishable from Christ et al. in view of Heiman et al., whereby the rejection under 35 U.S.C. §103 has been overcome. Reconsideration is respectfully requested.

In the Official Action, claims 15-16 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Christ et al. in view of Blevins et al. (U.S. Patent No. 6,445,962). The Examiner asserted that Blevins et al. disclose the use of a data communication network using a hypertext transfer communications protocol for the purposes of sending the tuning software to a remote location through the use of the Internet. The Examiner further asserted it would have been obvious to one of ordinary skill in the art to have incorporated the teachings of

Blevins et al. into Christ et al. so as to provide a way of tuning the system regardless of the geographical location of an operator or technician.

However, as will be set forth in detail below, it is submitted that the systems defined by claims 15 and 16 are non-obvious and patentably distinguishable from Christ et al. in view of Blevins et al. Accordingly, this rejection is traversed and reconsideration is respectfully requested.

As noted above, to establish prima facie obviousness of the claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka, supra* Moreover, in order for references to be relied upon to support a rejection under 35 U.S.C. § 103 they must provide an enabling disclosure, i.e., they must place the claimed invention in the possession of the public. *Glaxo Inc. v. Novopharm Ltd., supra*; *In re Payne, supra*. Christ et al. in view of Blevins et al. fail to satisfy these requirements.

The teachings of Christ et al. are discussed above. Blevins et al. disclose an auto-tuner for tuning a control element in a process control network having distributed control functions including a first tuning element located in the field device in which the control element is operating and a second tuning element located in a different device that communicates with the first device via a communications network. The deficiencies of Christ et al. are not overcome with the combination of Blevins et al. Moreover, Blevins et al. alone or in combination with Christ et al., fail to teach or suggest a motion control system comprising a feedforward tuning unit adapted to, *inter alia*, iii) determine error associated with the initial movement; iv) determine a potential value of the feedforward compensation parameter; v) cause the position command generator to produce position commands according to the test motion routine, wherein the potential value of the time-shift compensation parameter is used in the control of the actuator and the actuator undergoes movement; vi) determine error associated with the movement commanded in v); vii) compare

the errors associated with the movements; viii) select one of the values as a current best value, based on the act of comparing the errors; and ix) repeat actions iv) - viii) until the current best value is an optimum value, wherein the feedforward tuning unit compares the errors associated with at least two of the movements.

It is therefore submitted that the presently claimed methods are nonobvious over and patentably distinguishable from Christ et al. in view of Blevins et al., whereby the rejection under 35 U.S.C. §103 has been overcome. Reconsideration is respectfully requested.

In the Official Action, claim 18 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Christ et al. in view of Gabara (U.S. Patent No. 6,307,443). The Examiner conceded that Christ et al. fail to disclose tuning using a finite state machine. The Examiner asserted that Gabara discloses the use of a tuner wherein the tuner utilizes finite state machine. The Examiner further asserted it would have been obvious to one of ordinary skill in the art to have incorporated the teachings of Gabara into Christ et al. so as to provide a means by which maximum power may be achieved during the tuning process.

However, as will be set forth in detail below, it is submitted that the system defined by claim 18 is non-obvious and patentably distinguishable from Christ et al. in view of Gabara. Accordingly, this rejection is traversed and reconsideration is respectfully requested.

As noted above, to establish prima facie obviousness of the claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka, supra.* Moreover, in order for references to be relied upon to support a rejection under 35 U.S.C. § 103 they must provide an enabling disclosure, i.e., they must place the claimed invention in the possession of the public. *Glaxo Inc. v. Novopharm Ltd., supra*; *In re Payne, supra.* Christ et al. in view of Gabara fail to satisfy these requirements.

The teachings of Christ et al. are discussed above. Gabara discloses a method and system for tuning a tunable bandpass filter. The bandpass filter has a passband which is

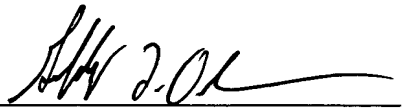
dependent on the value of the tuning signals. The power of the filtered signal is measured and the filter tuning is adjusted until the magnitude of the filtered signal power is at a maximum.

The deficiencies of Christ et al. are not overcome with the combination of Gabara. Moreover, Gabara. alone or in combination with Christ et al., fail to teach or suggest a motion control system comprising a feedforward tuning unit adapted to, *inter alia*, iii) determine error associated with the initial movement; iv) determine a potential value of the feedforward compensation parameter; v) cause the position command generator to produce position commands according to the test motion routine, wherein the potential value of the time-shift compensation parameter is used in the control of the actuator and the actuator undergoes movement; vi) determine error associated with the movement commanded in v); vii) compare the errors associated with the movements; viii) select one of the values as a current best value, based on the act of comparing the errors; and ix) repeat actions iv) - viii) until the current best value is an optimum value, wherein the feedforward tuning unit compares the errors associated with at least two of the movements.

It is therefore submitted that the presently claimed methods are nonobvious over and patentably distinguishable from Christ et al. in view of Gabara, whereby the rejection under 35 U.S.C. §103 has been overcome. Reconsideration is respectfully requested.

It is believed that the above represents a complete response to the Examiner's objections and rejections under 35 U.S.C. §§101, 102, 103 and 112 and places the present application in condition for allowance. Reconsideration and an early allowance are requested.

Respectfully submitted,

By 

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